

ABSTRACT OF THE DISCLOSURE

A micromechanical resonator device is disclosed that utilizes competition between the thermal dependencies of geometrically tailored stresses and Young's modulus to (1) reduce the temperature coefficient (TC_f) of the resonance frequencies of the micromechanical resonator device without any additional power consumption; and (2) introduce a zero TC_f temperature at which subsequent oven-controlled resonators may be biased. A key feature in this resonator design involves the strategic sizing of the geometries of the resonator and its support structure to harness thermal expansion temperature coefficients that oppose and cancel those of Young's modulus variation. This transforms the original monotonically decreasing resonance-frequency-versus-temperature curve to an S-shaped curve (or a linear one with a much smaller slope), with a smaller overall frequency excursion over a given temperature range, and with points at which the resonance frequency TC_f is zero. This design strategy is a key to attaining the needed temperature stability for reference oscillator applications in portable wireless communications and for RF channel-select filter banks. In addition, for cases where the thermal response of a resonator need not be nulled, but rather must satisfy a given shape, this technique can also be used to tailor a specific resonance frequency versus temperature curve.